RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 1998

BUDGET ACTIVITY: 3 - Advanced Technology Development

PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology

	COST *($ In Thousands*)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	55,467	50,832	40,153	40,138	39,975	39,810	41,855	Continuing	Continuing
3150	Advanced Optics Technology	11,423	16,506	1,362	1,674	2,549	2,625	2,712	Continuing	Continuing
3151	High Power Semiconductor Laser Technology	4,336	5,850	9,845	11,175	9,508	9,793	10,118	Continuing	Continuing
3152	High Power Microwave Technology	14,323	6,955	7,373	7,419	8,332	8,557	8,781	Continuing	Continuing
3647	High Energy Laser Technology	25,385	21,521	21,573	19,870	19,586	18,835	20,244	Continuing	Continuing
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

(U) A. Mission Description and Budget Item Justification: This Advanced Technology Development program demonstrates advanced directed energy and optical imaging concepts. Speed-of-light weapons and long-range, high resolution optical imaging through the turbulent atmosphere offer significant payoffs for many Air Force missions, such as theater missile defense, suppression of enemy air defenses, and control of space. This program has already demonstrated many major technological breakthroughs such as removing significant atmospheric distortions from optical transmissions (e.g., laser beams) and producing small, relatively high power laser diode phased arrays. Major emphasis areas include: high power microwave and high energy laser technologies; long-range optical imaging; and high power laser diodes and diode arrays. Because of the unique effects associated with high power microwaves there are many potential applications ranging from low power disruptions to high power destruction of electronic devices. Thus, a wide range of high power microwave technologies are being developed. Within high energy lasers the emphasis is on developing methods to increase the power on target. This is done by continuing to remove more of the atmospheric degradations and to develop more efficient laser devices. Long-range optical imaging offers high resolution images of space objects from the ground for applications such as satellite status assessments. High power diodes offer great potential for very small optical sources at many wavelengths for applications such as infrared illuminators and infrared countermeasure sources as well as high data rate secure communications. This PE will continue to develop a wide range of directed energy technologies for many DoD applications. Note: Congress added $10 million for space laser imaging and $6 million for Field Laser Demonstrator upgrades in FY 1998 which explains the perceived decease in FYs 1999 and out.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1998
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology

(U) B. Program Change Summary ($ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY 1998 PB)	54,027	41,238	41,660	Cont
(U) Appropriated Value	56,895	55,238		
(U) Adjustments to Appropriated Value				
a. Congressional/General Reductions	-1,723	-3,629		
b. SBIR	-1,145	-777		
c. Omnibus/Other Above Threshold Reprogrammings	-97			
d. Below Threshold Reprogrammings	1,627			
e. Rescissions	-90			
(U) Adjustments to Budget Year Since FY 1998 PB			-1,507	
(U) Current Budget Submit/FY 1999 PB	55,467	50,832	40,153	Cont

(U) Change Summary Explanation:

Funding: Changes to this PE since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary: Not Applicable.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1998
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3150

COST *($ In Thousands)*	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3150 Advanced Optics Technology	11,423	16,506	1,362	1,674	2,549	2,625	2,712	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project develops advanced optical technologies for locating, identifying, and analyzing distant and/or dim objects. This work supports high energy laser technologies because an imaging subsystem is required for target verification, accurate and sustainable laser beam placement on target, and near-real-time damage assessment. Several advanced technologies including nonlinear optics, adaptive optics, and specialized signal processing are being developed. The goal is high quality optical image reconstruction, concentrating on removing turbulent atmosphere-induced distortions. Many of the technologies developed/being developed have significant application to astronomy research.

(U) FY 1997 ($ in Thousands):

- (U) $680 Develop and demonstrate advanced optical imaging technologies that support applications such as space object imaging.
  - (U) Transitioned technology for daytime imaging of low-earth orbit satellites to the Maui Space Surveillance System 3.67 meter telescope. This capability dramatically increases the number of satellites imaged each day.
- (U) $309 Develop nonlinear optics technologies for non-mechanical corrections in optical imaging.
  - (U) Constructed, characterized, and demonstrated a laboratory breadboard of the telescope subsystem for an ultra-high resolution, lightweight imaging satellite telescope concept which uses nonlinear optics to compensate for deformations in a large diameter deployable primary mirror.
- (U) $844 Develop and demonstrate advanced, very long-range optical imaging technologies which increase resolution and data fusion to support missions such as space object identification and ground target identification from space.
  (U) Began development of field hardware to demonstrate feasibility of long-range optical imaging for space object identification/mission payload assessment, extending our reach, for the first time, to geosynchronous altitudes.
- (U) $9,590 Develop technologies for active imaging of geosynchronous space objects.
  - (U) Conducted active imaging field tests and demonstrations.
- (U) $11,423 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1998
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology / PROJECT: 3150

(U) FY 1998 ($ in Thousands):

- (U) $845 Develop and demonstrate advanced, very long-range optical imaging technologies which increase resolution and data fusion to support missions such as space object identification and ground target identification from space.
  - (U) Continue development of field hardware to demonstrate feasibility of long-range passive optical imaging for space object identification/mission payload assessment, extending our reach, for the first time, to geosynchronous altitudes.
  - (U) Demonstrate target identification using multispectral images from space to improve battle damage assessment and allow imagery of targets under all types of camouflage while reducing satellite size, weight, and cost.
- (U) $514 Develop nonlinear optics technologies for non-mechanical corrections in optical imaging.
  - (U) Design and model a brassboard based on the FY 1997 telescope subsystem breadboard for characterization in a space environmental chamber to evaluate operational properties.
- (U) $233 Develop and demonstrate signature technology for identifying and assessing health and status of satellites out to geosynchronous orbit.
  -- (U) Complete analysis and initiate field experiments to demonstrate spectral classification and status of satellites.
- (U) $9,321 Develop technologies for active imaging of geosynchronous space objects.
  - (U) Conduct active imaging field tests and demonstrations.
- (U) $5,593 Upgrade the Field Laser Demonstrator for increased resolution.
  - (U) Develop hardware and techniques to obtain very accurate data on space objects (position, velocity, etc) and techniques for remote sensing of the atmosphere (detect hazardous agents, etc).
- (U) $16,506 Total

(U) FY 1999 ($ in Thousands):

- (U) $618 Develop and demonstrate advanced technologies which increase resolution and data fusion for very long-range optical imaging to support missions such as space object identification and ground target identification from space.
  - (U) Continue development of field hardware to demonstrate feasibility of long-range passive optical imaging for space object identification/mission payload assessment, extending our reach, for the first time, to geosynchronous altitudes.
- (U) $548 Develop nonlinear optics technologies for non-mechanical corrections in optical imaging.
  - (U) Construct the ultra-high resolution, lightweight imaging satellite telescope brassboard designed in FY 1998 and evaluate in a space environmental chamber to determine actual capabilities.
- (U) $196 Develop and demonstrate signature technology for identifying and assessing health and status of satellites out to geosynchronous orbit.
  - Demonstrate utility of spectral classification and operational status analysis of satellites from data collected with the Ground-Based Electro-Optical Deep Space Surveillance test site.
- (U) $1,362 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE February 1998
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology	PROJECT 3150

(U) B. Program Change Summary ($ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY 1998 PB)	11,442	1,707	1,589	Cont
(U) Current Budget Submit/FY 1999 PB	11,423	16,506	1,362	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0305910F Spacetrack
- (U) PE 0305160F, Defense Meteorological Satellite Program.
- (U) PE 0602102F, Materials.
- (U) PE 0602601F, Phillips Laboratory.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1998
BUDGET ACTIVITY: 3 - Advanced Technology Development	PE NUMBER AND TITLE: 0603605F Advanced Weapons Technology / PROJECT: 3151

COST (*$ In Thousands*)	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3151 High Power Semiconductor Laser Technology	4,336	5,850	9,845	11,175	9,508	9,793	10,118	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project continues to yield revolutionary breakthroughs in compact, robust, and affordable laser system technology for a wide range of military applications requiring small compact laser sources with low to moderate optical power. This is a long-term technology development project with both near-term and long-term goals. Near-term goals include developing compact, reliable infrared sources for a range of applications including night vision systems, landing zone markers, remote sensing, and covert communication systems. Longer-term goals focus on producing compact, significantly higher power sources for military applications including aircraft protection. This project leads the development of and builds upon a wide range of commercial advancements. Commercially available semiconductor lasers are widely used due to their low-cost, small size and weight, high reliability, and high efficiency in converting electricity to laser energy. This project preserves these attractive features while continually scaling output to higher powers/efficiencies and/or to military application-specific wavelengths. The project is divided into three technology areas. The first area investigates methods to increase output power from individual laser diodes while increasing power density onto a small spot. Secondly, semiconductor laser array integration methods, which produce a single, high quality laser beam at significantly higher power levels are developed. Thirdly, wavelength-specific laser diodes for military applications are developed. Project scientists/managers also work directly with field users to develop proof-of-capability demonstrations and field tests for these revolutionary laser sources. This technology has many commercial applications, especially for eye-safe lasers.

(U) FY 1997 ($ in Thousands):

- (U) $2,360 Develop laser diodes for improved performance/higher power in near-term applications such as illumination, designation, and communication and for incorporation into laser diode array architectures.
  - (U) Demonstrated four watts of continuous wave output power from a single–mode fiber, improving current semiconductor laser state–of–the–art by a factor of 1.5. This demonstration identified technical issues which must be solved to reach higher power levels for increased space laser communication data rates and increased system security.
  - (U) Demonstrated devices that have the potential to be modulated and scaled to high powers.
- (U) $1,071 Develop laser diode arrays for improved performance/higher power in applications requiring high power levels and beam quality such as designating and tracking for Airborne Laser (ABL) and Ground-Based Laser (GBL).
  - (U) Developed phasing methods for the 200 watt continuous output power diode laser array developed in FY 1996.
- (U) $905 Demonstrate high power laser diode array technology that incorporates size limitations necessary for integration into system application designs.
  - (U) Demonstrated 200 watts continuous wave output power from a one cubic foot laser head. This laser design demonstrated the feasibility of a compact, high-power laser system.
- (U) $4,336 Total

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1998
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
PROJECT 3151	

(U) FY 1998 ($ in Thousands):

- (U) $1,386 Develop laser diodes for improved performance/higher power as sources in near-term applications such as infrared countermeasures, illumination, designation, and communication and for incorporation into laser diode array architectures.
  - (U) Identify and resolve reliability and failure mode issues to validate advanced high power, reliable, long-life diode lasers operating at 980 nanometers wavelength.
  - (U) Demonstrate one watt, continuous wave, diffraction-limited output power at 1.55 micrometers wavelength to extend the capabilities of current and future communication systems and enhance eye-safe sources.
- (U) $979 Develop coherent laser diode arrays for improved performance/higher power as sources in applications requiring high power levels.
  - (U) Evaluate design and trade off decisions related to high power semiconductor diode array ruggedness, compactness, and portability for integration into system application designs.
- (U) $1,660 Develop semiconductor diode lasers and optically-pumped semiconductor lasers to support current advanced infrared countermeasures (IRCM) system upgrades to tactical fixed and rotary-wing aircraft. Development will focus on concepts with the potential for high efficient, compact infrared laser sources covering Bands 2 and 4.
  - (U) Demonstrate one watt coherent peak output power at quasi-continuous wave operation from a single, Band 2 semiconductor diode at an operating temperature of 200 degrees Kelvin. This device will demonstrate the necessary powers needed to jam Band 2 infrared surface-to-air missiles.
  - (U) Demonstrate two watts coherent peak output power at quasi-continuous wave operation from a single, Band 4 optically-pumped semiconductor laser at an operating temperature of 85 degrees Kelvin. The collected data will demonstrate the necessary powers needed to jam Band 4 infrared surface-to-air missiles.
- (U) $1,825 Develop the basic laser source and target coupling technology needed to damage/destroy missile seeker components of next generation imaging advanced infrared guided air-to-air and surface-to-air missiles.
  - (U) Construct a first generation surrogate imaging threat to be used in laboratory testing. This surrogate is necessary as the availability of real world missile seeker assets to be used in destructive testing is severely limited and cost prohibitive.
  - (U) Demonstrate damage to representative focal plane array, the detector used in an imaging missile, from illumination with moderate power pulsed laser device.
- (U) $5,850 Total

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
	PROJECT 3151

(U) FY 1999 ($ in Thousands):

- (U) $1,869 Develop laser diodes for improved performance/higher power as sources in near-term applications such as illumination, designation, and communication and for incorporation into laser diode array architectures.
  - (U) Demonstrate a factor of three increase (three watts) in continuous wave, diffraction limited output power at 1.55 micrometers wavelength to enable new system concepts for communications.
  - (U) Identify and resolve reliability and failure mode issues to validate advanced high-power, reliable long-life diode laser systems operating at 1.55 micrometers wavelength.
- (U) $1,127 Develop scaleable laser arrays (fiber/diode) for improved performance in applications requiring high power levels and beam quality such as designating/tracking sources for the airborne laser and ground based laser applications and as weapon sources for degrade and damage in aircraft self-protection applications.
  - (U) Demonstrate a fieldable 0.1 cubic foot, 100 watt, steerable near-infrared building block laser array head. This array will demonstrate the practicality for scaling to the multi-kilowatt power levels required for next generation weapons systems.
- (U) $3,908 Develop semiconductor diode lasers and optically-pumped semiconductor lasers to support current advanced infrared countermeasures (IRCM) system upgrades to tactical fixed and rotary-winged aircraft. Development will focus on concepts with the potential for high efficiency, compact infrared laser sources covering Bands 2 and 4.
  - (U) Demonstrate one watt peak output power from a Band 2 semiconductor laser at an operating temperature of 200 degrees Kelvin with a beam quality compatible with the DoD tri-Service Advanced Threat IRCM (ATIRCM) system. This demonstration will provide the necessary beam quality needed to directionally focus power downrange and jam Band 2 infrared surface-to-air missiles.
  - (U) Demonstrate two watts peak output from a Band 4 optically-pumped semiconductor laser at an operating temperature of 85 degrees Kelvin with a beam quality compatible with the DoD tri-Service ATIRCM system. This device will demonstrate the necessary beam quality needed to directionally focus the power downrange and jam Band 4 surface-to-air missiles.
- (U) $2,941 Develop the basic laser source and target coupling technology needed to damage/destroy missile seeker components of next generation imaging advanced infrared guided air-to-air and surface-to-air missiles.
  - (U) In a static field test, demonstrate damage to seeker of the first generation surrogate imaging threat sufficient to cause the missile to miss the target aircraft.
  - (U) Perform hardware-in-the-loop testing of damage mechanisms within the surrogate imaging threat. This testing will verify that damage caused in the static field test is sufficient to cause surrogate system malfunction, and that a missile guidance system would be sufficiently degraded to cause a low probability of missile impact with the target aircraft.
  - (U) Construct an improved surrogate threat to be used in laboratory testing. This surrogate, to be ready for testing in FY 2000, will be of higher fidelity than the first generation surrogate developed in FY 1998.
- (U) $9,845 Total

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
	PROJECT 3151

(U) B. Program Change Summary ($ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY 1998 PB)	4,440	6,410	10,043	Cont
(U) Current Budget Submit/FY 1999 PB	4,336	5,850	9,845	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602102F, Materials.
- (U) PE 0602204F, Aerospace Avionics.
- (U) PE 0603270F, Electronic Combat Technology
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0602234N, Systems Support Technology.
- (U) Representatives from Army, Navy, Ballistic Missile Defense Organization, National Laboratories, and Air Force using commands are members of the government review team for this technology.
- (U) Joint field demonstrations of this technology are ongoing with: the Air Force Pararescue School; the Air Force Special Operations Command; the U.S. Coast Guard; and the U.S. Customs Service.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1998
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3152

COST *($ In Thousands)*	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3152 High Power Microwave Technology	14,323	6,955	7,373	7,419	8,332	8,557	8,781	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project develops high power microwave generation technologies. It also develops a susceptibility/vulnerability/lethality data base to identify potential vulnerabilities of U.S. systems to high power microwave threats and to provide a basis for future offensive and defensive weapons system decisions. Representative U.S. and foreign assets will be tested to understand real system susceptibilities. Both wideband (wide frequency range) and narrowband (very small frequency range) technologies are being developed. The technologies developed in this project will demonstrate the applicability of high power microwaves that can damage/degrade/deny/destroy electronic systems and subsystems for missions such as suppression of enemy air defense, command and control warfare, and aircraft self-protection.

(U) FY 1997 ($ in Thousands):

- (U) $3,125 Develop suppression of enemy air defense technologies.
  - (U) Conducted experiments on selected integrated air defense assets.
  - (U) Completed detailed systems engineering specifications for high power microwave suppression of enemy air defenses weapon concept.
  - (U) Completed explosive pulse power development for suppression of enemy air defenses weapon concept.
  - (U) Completed source development for suppression of enemy air defenses weapon concept.
- (U) $3,004 Develop aircraft self-protection technologies.
  - (U) Completed high power microwave hardening criteria evaluation for large U.S. aircraft.
  - (U) Completed required electromagnetic hardening on range assets used for technology demonstration field test.
  - (U) Continued development of wideband high power microwave brassboard for field demonstrations.
  - (U) Conducted laboratory experiments on missiles to identify alternative/enhanced kill mechanisms.
  - (U) Completed technology demonstration field test planning.
  - (U) Initiated plan to transition technology to large aircraft system program offices.
- (U) $1,168 Develop command and control warfare technologies.
  - (U) Continued equipment characterization of command and control assets.
  - (U) Expanded propagation studies and models for various construction materials/techniques.
  - (U) Continued development of wideband sources and antennas for command and control warfare applications.
  - (U) Initiated studies of potential delivery and implementation techniques.

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PROJECT 3152	

– (U) $4,795 Develop laser-induced microwave emissions technology.
  – (U) Validated the integrated response model of the laser-induced microwave emission phenomenon.
  – (U) Completed experiments, begun in FY 1996, on operational systems and developed draft hardening specifications.
  – (U) Completed feasibility experiments and analyzed results for various applications.
– (U) $500 Develop active denial technology.
  – (U) Began application concept studies for next-generation technology.
– (U $ 1,731 Develop high power microwave space control technologies.
  – (U) Completed concept study threat basing mode analysis.
  – (U) Performed subsystem and component level susceptibility experiments on satellite communication, imaging, and control technologies.
  – (U) Evaluated source technologies for threat demonstration.
– (U) $14,323 Total

(U) FY 1998 ($ in Thousands):
– (U) $3,014 Develop suppression of enemy air defense technologies.
  – (U) Conduct critical experiments of integrated pulsed power generator and high power microwave source.
  – (U) Conduct subsystem level effects test of an integrated air defense asset.
  – (U) Start engineering design of high power microwave suppression of enemy air defenses weapon brassboard.
– (U) $2,271 Develop technologies to support advanced tactical applications.
  – (U) Complete wideband high power microwave brassboard for technology demonstration field test.
  – (U) Conduct field experiments for demonstrate self-protect technology.
  – (U) Complete plan to transition technology to large aircraft systems program office.
  – (U) Final assessment of wideband high power microwave technology's ability to effectively counter missile threats prior to transition to large aircraft system program offices.
– (U) $1,198 Develop command and control warfare technologies.
  – (U) Expand equipment characterization experiments and effects database.
  – (U) Begin selection of wideband source and pulse power designs.
  – (U) Develop delivery and implementation options.
– (U) $472 Develop active denial technology.
  – (U) Continue application concept studies for next-generation technology.
– (U) $6,955 Total

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(U) FY 1999 ($ in Thousands):

- (U) $3,354 Develop suppression of enemy air defense technologies.
  - (U) Complete critical experiment of high power microwave suppression of enemy air defenses technologies.
  - (U) Continue to conduct experiments on selected integrated air defense assets.
  - (U) Initiate advanced repetitive source development for suppression of enemy air defenses.
- (U) $2,357 Develop technologies to support advanced tactical applications.
  - (U) Continue development of high power microwave sources and antennas for aircraft self-protect and other advanced tactical applications.
  - (U) Continue to assess candidate high power microwave weapon effects on U.S. and foreign systems and identify mitigation technologies.
  - (U) Begin to develop or adapt engagement models for candidate weapon systems.
- (U) $1,172 Develop command and control warfare technologies.
  - (U) Finalize first wideband source and pulse power design for ground control network application.
  - (U) Complete initial equipment characterization of command and control assets.
  - (U) Continue effects experiments on electromagnetic propagation into command and control facilities.
- (U) $490 Develop active denial technology.
  - (U) Continue application concept studies for next-generation technology.
- (U) $7,373 Total

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
	PROJECT 3152

(U) B. Program Change Summary ($ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY 1998 PB)	14,347	7,363	7,521	Cont
(U) Current Budget Submit/FY 1999 PB	14,323	6,955	7,373	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602202F, Human Systems Technology.
- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0602120A, Electronic Survivability and Fuzing Technology.
- (U) PE 0602111N, Anti-Air Warfare, Anti-Surface Warfare Technology.
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1998
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology PROJECT 3647

COST *($ In Thousands)*	FY 1997 Actual	FY 1998 Estimate	FY 1999 Estimate	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	Cost to Complete	Total Cost
3647 High Energy Laser Technology	25,385	21,521	21,573	19,870	19,586	18,835	20,244	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification: This project provides for the development, demonstration, and detailed assessment of technology needed for high energy laser weapons. Near-term focus is on ground-based and airborne high energy laser missions, although the technology developed for this project is directly applicable to most high energy laser applications. Critical technologies demonstrated include: scaleable laser devices, with near-term emphasis on the Chemical Oxygen-Iodine Laser (COIL); optical components; and laser beam control to efficiently compensate and propagate laser radiation through the atmosphere to a target. Detailed computational models to establish high energy laser weapon effectiveness and satellite and missile vulnerability will be developed. Correcting the laser beam for distortions induced by propagation through the turbulent atmosphere is the key technology in most high energy laser applications. The beam control technology developed in this project has a significant benefit to the astronomy community.

(U) FY 1997 ($ in Thousands):

- (U) $2,970 Develop and demonstrate high energy laser components for potential weapon applications.
  - (U) Identified specific energy loss mechanisms in chemical oxygen-iodine laser (COIL) devices, based on results of COIL diagnostic testing and modeling, and began development of advanced concepts to reduce losses and improve COIL device performance.
  - (U) Developed the magnetic gain switch hardware necessary to efficiently operate a COIL device as a repetitively-pulsed laser, a necessary step in using a wavelength-shifted COIL device in illuminator applications.
- (U) $1,468 Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems protected against laser threats.
  - (U) Continued to conduct laser vulnerability experiments on satellite subsystems.
  - (U) Continued to perform detailed vulnerability analysis on satellite optical payload systems.
  - (U) Continued detailed satellite vulnerability assessments on satellites using newly incorporated uncertainty methodology.
  - (U) Continued assessing the potential of near-term laser countermeasures on satellites.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 1998
BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
PROJECT 3647	

– (U) $10,120 Perform atmospheric compensation/beam control experiments from ground-based and airborne platforms to support applications ranging from weaponization to space object identification.
  – (U) Began design of a two laser beacon system for full-scale atmospheric compensation on the 3.5 meter telescope.
  – (U) Demonstrated real-time compensation of atmospheric turbulence-induced distortions on satellite images.
  – (U) Installed 500 watt laser tracking illuminator system and began satellite active tracking experiments to evaluate synergistic effects with atmospheric compensation and demonstrate 24-hour satellite tracking.
  – (U) Completed integration of first-generation adaptive optics on Starfire Optical Range (SOR) 3.5 meter telescope and began imaging tests using stars. Testing results will identify hardware and software issues which need to be addressed to improve atmospheric compensation performance.
  – (U) Continued development of second-generation adaptive optics system to maximize resolution and compensation of the SOR 3.5 meter telescope.

– (U) $10,827 Characterize atmospheric attenuation and distortion on laser beam propagation, conduct atmospheric compensation and beam control experiments, and develop an airborne ultra-precision inertial pointing system to enhance boost phase theater ballistic missile tracking.
  – (U) Completed analysis and evaluation of global atmospheric optical data taken in FY 1995 airborne experiments.
  – (U) Collected atmospheric aerothermal data for strategic locations worldwide to develop parametric database for high energy laser operational assessments analysis.
  – (U) Correlated atmospheric aerothermal and optical parameters in an analytical model to provide a cost-effective method of determining laser weapon effectiveness against specific threats.
  – (U) Designed near full-scale acquisition, tracking, and pointing experiments to demonstrate and validate atmospheric compensation, tracking, and laser beam control techniques against fixed targets and boost phase theater ballistic missiles. The experiments were conducted at White Sands Missile Range, NM.
  – (U) Designed small-scale laboratory and field experiments to explore innovative atmospheric compensation, tracking, and laser beam control options reducing the technical risk of developing airborne high energy laser weapons.

– (U) $25,385 Total

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BUDGET ACTIVITY 3 - Advanced Technology Development	PE NUMBER AND TITLE 0603605F Advanced Weapons Technology
PROJECT 3647	

(U) FY 1998 ($ in Thousands):

- (U) $2,550 Develop and demonstrate high energy laser components for potential weapon applications.
  - (U) Increase fieldability of the Chemical Oxygen Iodine Laser (COIL) for airborne and ground-based weapon systems by examining new nozzle designs, transport gases, and cavity design to increase efficiency, and reduce size and weight.
  - (U) Demonstrate repetitively-pulsed COIL device suitable for use in wavelength-shifted COIL illuminator laser applications.
  - (U) Select Raman wavelength-shifting concept and begin design of laboratory hardware to demonstrate high average power when coupled with a repetitively-pulsed COIL device.
- (U) $1,822 Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems protected against laser threats.
  - (U) Continue to conduct laser vulnerability experiments on satellite subsystems.
  - (U) Continue to perform detailed vulnerability analysis on satellite optical payload systems.
  - (U) Continue detailed satellite vulnerability assessments using newly incorporated uncertainty methodology.
  - (U) Continue assessing the potential of near-term laser countermeasures on satellites.
- (U) $914 Investigate and develop advanced, high energy laser optical components.
  - (U) Continue to develop and evaluate techniques to monitor optical components installed in future operational high-energy laser systems.
  - (U) Continue to optimize deposition techniques and characterization of low absorption, low-scatter optical thin film coatings for uncooled optics and other specialized applications. Transfer technology to industry for scaling.
  - (U) Build and evaluate the performance of a cooled, transmissive optical element in the Thermal Distortion Test Facility. Determine the distortion due to simulated high-energy laser heating.
- (U) $9,668 Perform atmospheric compensation and laser beam control experiments from ground-based platforms to support applications ranging from weaponization to space object identification.
  - (U) Complete design and begin development of two-laser beacon system for atmospheric compensation on the 3.5 meter telescope.
  - (U) Integrate second-generation adaptive optics system on 3.5 meter telescope to improve image quality of observed space objects.
  - (U) Continue satellite active tracking experiments to evaluate synergistic effects with atmospheric compensation and demonstrate 24-hour satellite acquisition and tracking capability.
- (U) $6,567 Characterize atmospheric attenuation and distortion on laser beam propagation, conduct atmospheric compensation and beam control experiments, and develop an airborne ultra-precision inertial pointing brassboard to enhance boost phase theater ballistic missile tracking.
  - (U) Conduct near full-scale tracking and pointing experiments that demonstrate and validate atmospheric compensation, tracking, and laser beam control techniques against fixed targets. The experiments will be conducted at White Sands Missile Range, NM.
  - (U) Conduct small-scale laboratory and field experiments to explore innovative atmospheric compensation, tracking, and laser beam control options reducing the technical risk of developing airborne high energy laser weapons.

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– (U) $21,521 Total

(U) FY 1999 ($ in Thousands):

– (U) $2,185 Develop and demonstrate high energy laser components for potential weapon applications.
  – (U) Demonstrate improved performance and fieldability with the Chemical Oxygen Iodine Laser (COIL) and support enhanced transition to the Airborne Laser system acquisition program.
  – (U) Demonstrate a repetitively pulsed, high average power, frequency-shifted COIL device for use as a target illuminator.
  – (U) Conduct high power laser technology development to ensure operation control of space and the tactical and strategic theaters.

– (U) $1,693 Perform vulnerability assessments on potential high energy laser targets to provide critical data for designing laser systems which can defeat a range of targets and to provide critical data for designing systems protected against laser threats.
  – (U) Continue to conduct laser vulnerability experiments on satellite subsystems.
  – (U) Continue to perform detailed vulnerability analysis on satellite optical payload systems.
  – (U) Continue detailed satellite vulnerability assessments using newly incorporated uncertainty methodology.
  – (U) Continue assessing the potential of near-term laser countermeasures on satellites.

– (U) $746 Investigate and develop advanced, high energy laser optical components.
  – (U) Continue to evaluate techniques to monitor optical components installed in an future operational high-energy laser systems. Transfer monitoring equipment to users. Such techniques are useful for predicting performance degradation and/or catastrophic failure of an optical component in an operational high energy laser system.
  – (U) Continue to optimize very low absorption, low-scatter optical thin film coatings. Transfer technology to industry for scaling. Low absorption, low scatter, durable coatings are critical to the performance of uncooled optics planned for future high-energy laser systems.

– (U) $11,200 Perform atmospheric compensation and laser beam control experiments from ground-based platforms to support applications ranging from weaponization to space object identification.
  – (U) Demonstrate atmospheric compensation of images using dual laser beacon system on 3.5 meter telescope.
  – (U) Continue active satellite tracking to investigate phenomena resulting from satellite illumination at various engagement geometries.
  – (U) Demonstrate compensated laser propagation to satellites on 3.5 meter telescope.
  – (U) Use track jitter compensation with atmospheric compensation and active tracking to point a laser with sufficient accuracy to maintain a selected aimpoint on a satellite target.

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– (U) $5,749 Characterize atmospheric attenuation and distortion on laser beam propagation, conduct atmospheric compensation and beam control experiments, and develop an airborne ultra-precision inertial pointing brassboard to enhance boot phase theater ballistic missile tracking.
  – (U) Collect atmospheric aerothermal data for strategic locations worldwide to develop parametric database for high energy laser operational assessments analysis.
  – (U) Continue near full-scale acquisition, tracking, and pointing experiments that demonstrate and validate atmospheric compensation, target tracking, and laser beam control techniques against fixed targets and boost phase theater ballistic missiles. The experiments will be conducted at White Sands Missile Range, NM.
  – (U) Instrument an aircraft for use as a dynamic target in White Sands Missile Range, NM, atmospheric propagation experiments. The aircraft will gather data to support future Airborne Laser technology development/risk reduction experiments.
  – (U) Continue small-scale laboratory and field experiments to explore innovative atmospheric compensation, tracking, and laser beam control options reducing the technical risk of developing airborne high energy laser weapons.

– (U) $21,573 Total

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(U) B. Program Change Summary ($ in Thousands):

	FY 1997	FY 1998	FY 1999	Total Cost
(U) Previous President's Budget (FY 1998 PB)	23,798	25,758	22,507	Cont
(U) Current Budget Submit/FY 1999 PB	25,385	21,521	21,573	Cont

(U) Change Summary Explanation:

Funding: Changes to this project since the previous President's Budget are due to higher priorities within the Science and Technology (S&T) Program.

Schedule: Not Applicable.

Technical: Not Applicable.

(U) C. Other Program Funding Summary:

(U) Related Activities:

- (U) PE 0602601F, Phillips Laboratory.
- (U) PE 0603319F, Airborne Laser Demonstration.
- (U) PE 0305910F, Spacetrack.
- (U) PE 0603217C, Ballistic Missile Defense, Advanced Development (High Altitude Balloon Experiment).
- (U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Schedule Profile: Not Applicable.

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